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PILATUS PORTER - PROVISION OF REVISED TAKE-OFF AND LANDING PERF--ETC(U)
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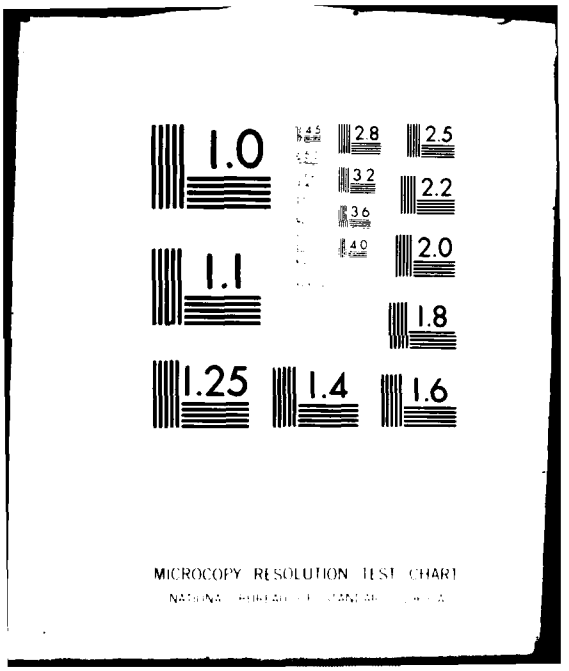
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AIRCRAFT RESEARCH AND DEVELOPMENT UNIT

FLIGHT TEST REPORT

PILATUS PORTER
PROVISION OF REVISED TAKE-OFF AND LANDING PERFORMANCE DATA

EDINBURGH

AUGUST 1980

ACTION AUTHORITY

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The provision of additional take-off and landing data to extend Pilatus Porter flight manual information from the previous gross weight limit of 5700 lb (2585 kg) to the currently authorised limit of 6100 lb (2767 kg) was requested under Technical Investigation No 698. Using ARDU computer facilities, the existing flight manual take-off and landing data were extrapolated to predict performance at the increased weight. Take-off and landing performance was then evaluated during five test periods totalling 5.5 hours in day VMC. Tests were conducted with aircraft gross weight in the range 4380 - 6090 lb (1987 - 2762 kg) using sealed and grassed runways.

Aircraft performance was also evaluated with external stores carried on underwing racks. The data generated satisfied both the currently available performance charts and the predicted performance from the extrapolated charts. Carriage of the external stores on the wing racks increased the ground roll by 50% and the distance to climb to 50 ft by 20%. Operation from short dry grass did not significantly affect take-off distances but landing distances were reduced by 20%. Inclusion of the revised charts in the flight manual is recommended.

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AIRCRAFT RESEARCH AND DEVELOPMENT UNIT

TECHNICAL INVESTIGATION NO 698

PILATUS PORTER
PROVISION OF REVISED TAKE-OFF AND LANDING PERFORMANCE DATA

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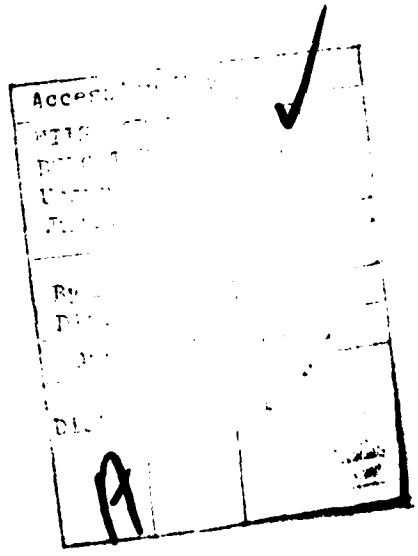

AIRCRAFT RESEARCH AND DEVELOPMENT UNIT

TECHNICAL INVESTIGATION NO 698

PILATUS PORTER
PROVISION OF REVISED TAKE-OFF AND LANDING PERFORMANCE DATA

SUMMARY

The provision of additional take-off and landing data to extend Pilatus Porter flight manual information from the previous gross weight limit of 5700 lb (2585 kg) to the currently authorised limit of 6100 lb (2767 kg) was requested under Technical Investigation No 698. Using ARDU computer facilities, the existing flight manual take-off and landing data were extrapolated to predict performance at the increased weight. Take-off and landing performance was then evaluated during five test periods totalling 5.5 hours in day VMC. Tests were conducted with aircraft gross weight in the range 4380 - 6090 lb (1987 - 2762 kg) using sealed and grassed runways.

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Report No TI 698

PILATUS PORTER
PROVISION OF REVISED TAKE-OFF AND LANDING PERFORMANCE DATA

References

A. Technical Investigation No 698 dated 18 January 1980

B. AAP 7211.001-1 Flight Manual - Pilatus Porter, amended to Amendment List 6 dated May 1979

C. ARDU Test Schedule No 1612 Part 2 dated November 1971, Pilatus Porter Flight Clearance

INTRODUCTION

1. Reference A instructed Aircraft Research and Development Unit (ARDU) to provide additional take-off and landing data to extend the Porter Flight Manual (Reference B) graphs at Figures A-8 through A-11 from an all-up-weight (AUW) of 5700 lb (2585 kg) to 6100 lb (2767 kg).

2. The PC-6/B1-H2 Porter aircraft is a single engined, strut braced high wing monoplane of all-metal construction manufactured by Pilatus Aircraft Ltd of Switzerland. It is designed for use as a utility aircraft. The cockpit has side-by-side seating for a crew of two and the cargo compartment, behind the crew, may be used to carry six passengers or cargo. The aircraft is fitted with a conventional, fixed landing gear with spring/oil shock absorbers and may be operated from rudimentary landing areas. The tail wheel is steerable. Wheel brakes are hydraulically operated. Flying controls are operated by cables, chains and push rods. A Pratt and Whitney PT6A-20 free turbine engine with a take-off power rating of 550 SHP provides power to the aircraft. The single stage power turbine drives a Hartzell three bladed, constant speed, full feathering, reversible pitch propeller via a reduction gearbox. A detailed description of the Porter is contained in Reference B.

CONDITIONS RELEVANT TO TESTS

Test Aircraft

3. Porter A14-702 was a standard aircraft fitted with 24.7 in (627.4 mm) main wheel tyres and a MA4A stores rack at the two underwing hardpoints throughout the tests. At the commencement of tests, airframe hours were 5164.9 and the external condition was good. Aircraft basic weight was established at 3396 lb (1540 kg) from the weight and balance history. PT6A-20 engine serial number PCE 21665 was installed and had a data plate rating of 476 SHP at 94.8% gas producer speed (ie 35550 RPM). At the commencement of tests, engine hours were 4436.1 since new and 1324.5 since overhaul.

/Engine

Engine performance during the tests met the requirements for acceptable engines. Performance with external loads was obtained using 200 litre drums filled with water attached to both stores racks.

Operating Limitations

4. The aircraft was operated within the limits specified in Section 5 of the flight manual (Reference B) with the exception that maximum AUW was increased to 6100 lb (2767 kg). Above 4850 lb (2200 kg), the requirements of DEFARM Special Flying Instruction 4/79 were observed. This requires landing with a touchdown rate of descent less than 450 ft/min (137 m/min).

Weather, Time and Location

5. Five day VMC flights, totalling 5.5 hours, were flown over the period 17 to 21 March 1980 at RAAF Base Edinburgh. Tests were flown by an Army pilot accompanied by an ARDU test pilot. The sealed (36/18) and grass (04/22) runways were used. Both runways have negligible slope and had been surveyed for tracking cameras. Tests were conducted in fine, nonturbulent conditions with an average headwind of 5 kn and crosswind averaging 4 kn. Temperature ranged from 28°C to 34°C during the tests.

Instrumentation

6. Each take-off and landing was recorded by a kinetheodolite positioned on the south-west corner of the balcony around the control tower. Prevailing wind during each test was measured on a portable anemometer positioned beside the runway. Standard aircraft instruments were used for cockit data which were recorded manually. Raw kinetheodolite data were converted to distance measurements at Defence Research Centre Salisbury.

Method of Test

7. A ground party, positioned on the side of the runway consisted of:

a. a met observer, with a portable met station (including an integrating anemometer);

b. kinetheodolite tracking team; and

c. kinetheodolite/aircraft co-ordinator with radio link to the aircraft.

Brakes release and 50 ft (15 m) height estimates were identified by radio calls. The pilot attempted to track the runway centre during take-off and landing. The take-offs to, or landings from 50 ft (15 m) were recorded by kinetheodolite. Results from the kinetheodolite record were then compared to the take-off and landing distances predicted from the extrapolation of existing data in Appendix 1 of the flight manual (Reference B).

/TESTS

TESTS MADE

8. The take-off and landing charts at Figures A-8 through A-11 of the flight manual (Reference B) are reduced from Annexes A through D of ARDU TS 1612 Part 2 (Reference C). Annexes A through C of Reference C were extrapolated from 5700 lb (2585 kg) to 6100 lb (2767 kg) using the ARDU computer curve fitting routine 'DECLOBINO'. The extrapolation was then used to predict take-off and landing distances at the increased AUW.

9. A total of twenty-three take-offs and landings were made under the conditions detailed in Table 1:

TABLE 1 - TEST CONDITIONS

All Up Weight (lb avg)	Centre of Gravity [1] (in avg)	Torque [2] (psi)	Wind (kn avg)		Outside Air Temperature (^{o}C)	Pressure Altitude (ft)
			head	cross		
4450	137	37 & 35	6	7	34	-30
5530	141	39 & 35	5	3	28	-80
5930	146	38.5	6	3	30	-70
6000 [3]	142	37	3	4	34	-50

Notes: 1. CG positions are mid-range except at 5930 and 6000 lb where they are near the aft and forward limit respectively for these weights and configurations.

2. Application of max torque prevented by ITT limit.

3. External stores (2 x 200 litre drums of water).

The following take-off and landing tests were made:

a. short field take-off;

b. normal landing;

c. short field landing;

d. grass field operations; and

e. take-off and landing with external stores.

RESULTS AND DISCUSSION

Short Field Take-off

10. Take-offs were made under the test conditions of Table 1, using the short take-off technique detailed in Section 2 of the flight manual (Reference B) with flaps at 28^{o}. The procedure was:

/a. hold

a. hold aircraft on brakes as take-off power applied;

b. release brakes;

c. maintain three point attitude during ground roll; and

d. maintain lift-off attitude to 50 ft.

For AUW less than 4850 lb (2200 kg), the minimum climb speed was 55 KIAS while 60 KIAS was used for AUW above 4850 lb (2200 kg). Actual distances recorded were 10-20% less than those obtained from the charts; however, the charts include a 10% increase factor as discussed in Reference C (TS 1612 Part 2). The short field take-off charts at Annexes A and B, when used with the appropriate technique, can be adopted for Porter PC-6/B1-H2 operations. Annexes A and B are recommended for inclusion in Reference B (flight manual) replacing figures A-8 and A-9 of Appendix 1.

Normal Landing

11. Normal landings were made under the test conditions of Table 1 using the normal landing technique detailed in Section 2 of the flight manual (Reference B). A minimum approach speed of 55 KIAS was used for AUW less than 4850 lb (2200 kg), while 60 KIAS was used for AUW above 4850 lb (2200 kg). Following the three point touchdown, wheel braking was used without reverse thrust. These landings gave results which were 5-10% less than the distances obtained from the charts; however, the landing charts include factors as discussed in Reference C (TS 1612 Part 2). The normal landing chart at Annex C, when used with the appropriate technique, can be adopted for Porter PC-6/B1-H2 operations. Annex C is recommended for inclusion in Reference B (flight manual) to replace figure A-10 of Appendix 1.

Short Field Landing

12. Short field landings were made under the test conditions of Table 1 using the short landing technique as detailed in Section 2 of the flight manual (Reference B). At the three point touchdown, maximum reverse thrust and maximum braking were applied until the aircraft stopped. Results had poor repeatability ranging from 15% more to 7% less than the distance predicted by the chart. The short landing distance is sensitive to variations in pilot technique and crosswind. During this series of tests in 5 kn crosswind, wing lift requiring full aileron for control was experienced. The tactical landing chart at Annex D, when used with beta approach and short landing can be adopted for Porter PC-6/B1-H2 operations. Annex D is recommended for inclusion in Reference B (Flight Manual) to replace figure A-11 of Appendix 1.

Grass Field Operations

13. Grass field take-offs and landings were made under the test conditions of Table 1. Operation from short dry grass on a well compacted surface made little difference to the take-off distances involved. Landing distances were reduced by a minimum of 20% of the sealed surface distance. Most of this reduction is attributed to pilot confidence in being able to apply more severe braking than on a sealed surface without increasing the risk of tyre damage.

/Take-off

Take-off and Landing with External Stores

14. Take-offs and landings were performed with an external load at both underwing stations under the test conditions detailed in Table 1. The external load weighed 480 lb (218 kg) with a frontal area of 2.8 ft^2 (0.26 m^2). Take-off distances with these external stores required a 50% increase in ground roll and a 20% increase in distance to 50 ft (15 m). Landing distances were increased by 15%. Within the scope of this test, take-off and landing performance with external stores at maximum AUW are satisfactory. The inclusion of the following notes at the nominated locations in Appendix 1 of Reference B (Flight Manual) is recommended:

a. Following paragraph A102:

With a 480 lb (218 kg) external store having a frontal area of 2.8 ft^2 (0.26 m^2) at each wing point, the ground roll distance should be increased by 50%.

b. Following paragraph A103:

With a 480lb (218 kg) external store having a frontal area of 2.8ft^2 (0.26 m^2) at each wing point, the distance for take-off and climb to 50 ft should be increased by 20%.

Flight With Asymmetric Store Loading

15. The right hand store was released in level flight with no flap at 100 KIAS and 1000 ft (305 m) AGL. Handling characteristics during and immediately following release of the store were satisfactory. The aircraft was then flown in level and climbing flight between 60 and 100 KIAS. No adverse characteristics were encountered. Handling characteristics during the short landing made in the asymmetric external load configuration were satisfactory. However, pilot workload and aircraft controllability will be improved by maintaining the highest practicable speed. Consideration should be given to making a flapless landing if field length is sufficient. The following note is recommended for inclusion in Section 3 of the Flight Manual after paragraph 323:

Pilot workload and aircraft controllability with an asymmetric load will be improved by maintaining the highest speed practicable; consideration should also be given to making a flapless landing if field length permits.

/CONCLUSIONS

CONCLUSIONS

16. The validity of the revised performance graphs was confirmed by flight test results and the charts at Annexes A through D can be adopted for Porter operations (paragraphs 10, 11 and 12).

17. Compared to distances on sealed surfaces, operations from short dry grass on a well compacted surface produced no appreciable difference in take-off distance but reduced landing distance by 20% (paragraph 13).

18. Operations with external loads of 480 lb (218 kg) having a frontal area of 2.8 ft^2 (0.26 m^2) increased take-off ground roll by 50% and distance to 50 ft by 20% (paragraph 14).

19. Handling characteristics with an asymmetric store were satisfactory (paragraph 15).

RECOMMENDATIONS

20. The revised charts at Annexes A through D should be included in Appendix A of the Flight Manual (Reference B) as amendments to Figures A-8 through A-11 (paragraphs 10, 11, and 12).

21. The following note should be included after paragraph 323 in Section 3 of the Flight Manual (paragraph 15):

> Pilot workload and aircraft controllability with an asymmetric load will be reduced by maintaining the highest speed practicable; consideration should also be given to making a flapless landing if field length permits.

22. The following notes should be included in Appendix 1 of the Flight Manual at the nominated locations (paragraph 14):

a. After paragraph A102:

> With a 480 lb (218 kg) external store having a frontal area of 2.8 ft^2 (0.26 m^2) at each wing point, the ground roll distance should be increased by 50%.

b. After paragraph A103:

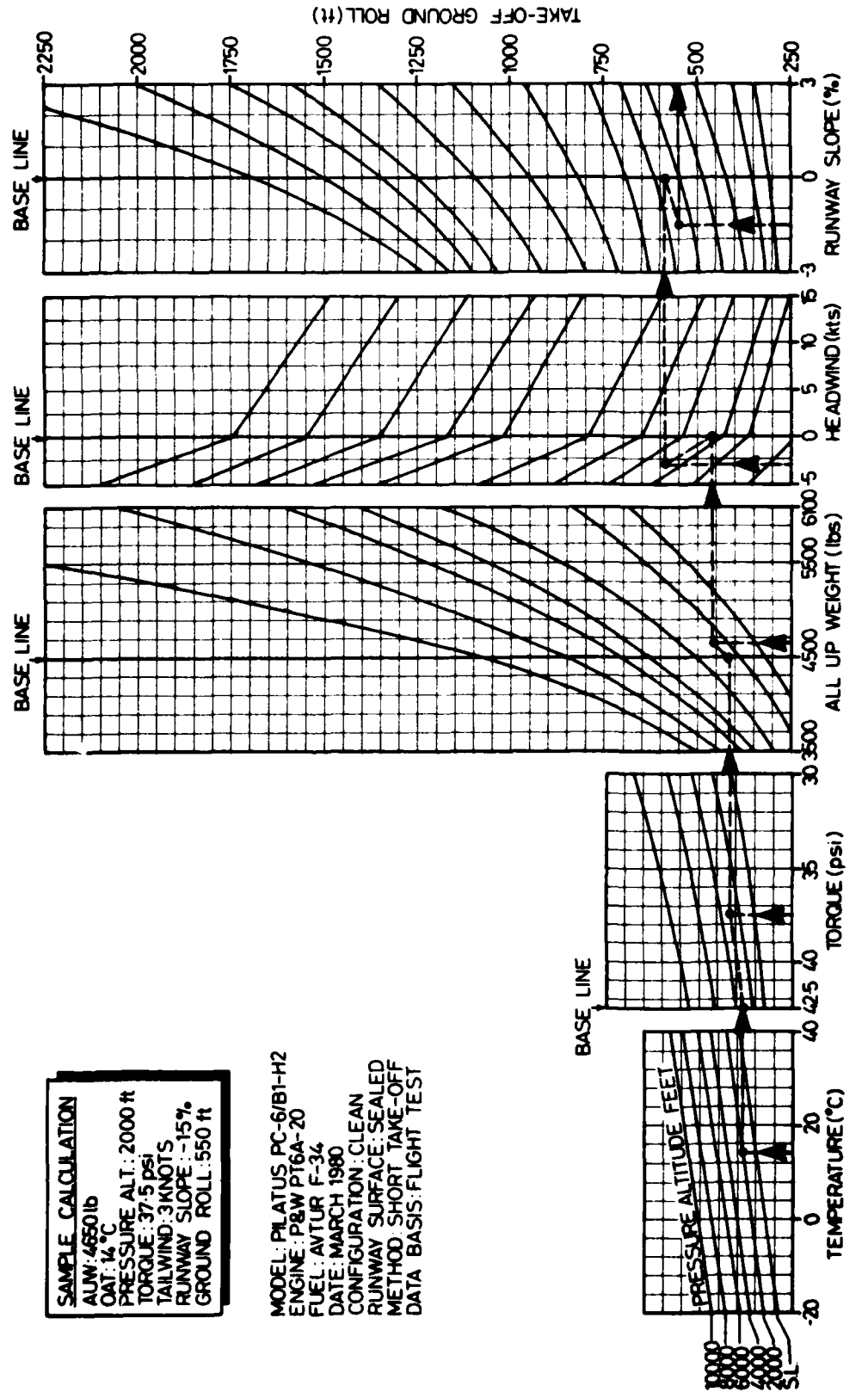
> With a 480 lb (218 kg) external store having a frontal area of 2.8 ft^2 (0.26 m^2) at each wing point, the distance for take-off and climb to 50 ft should be increased by 20%.

PROJECT PERSONNEL

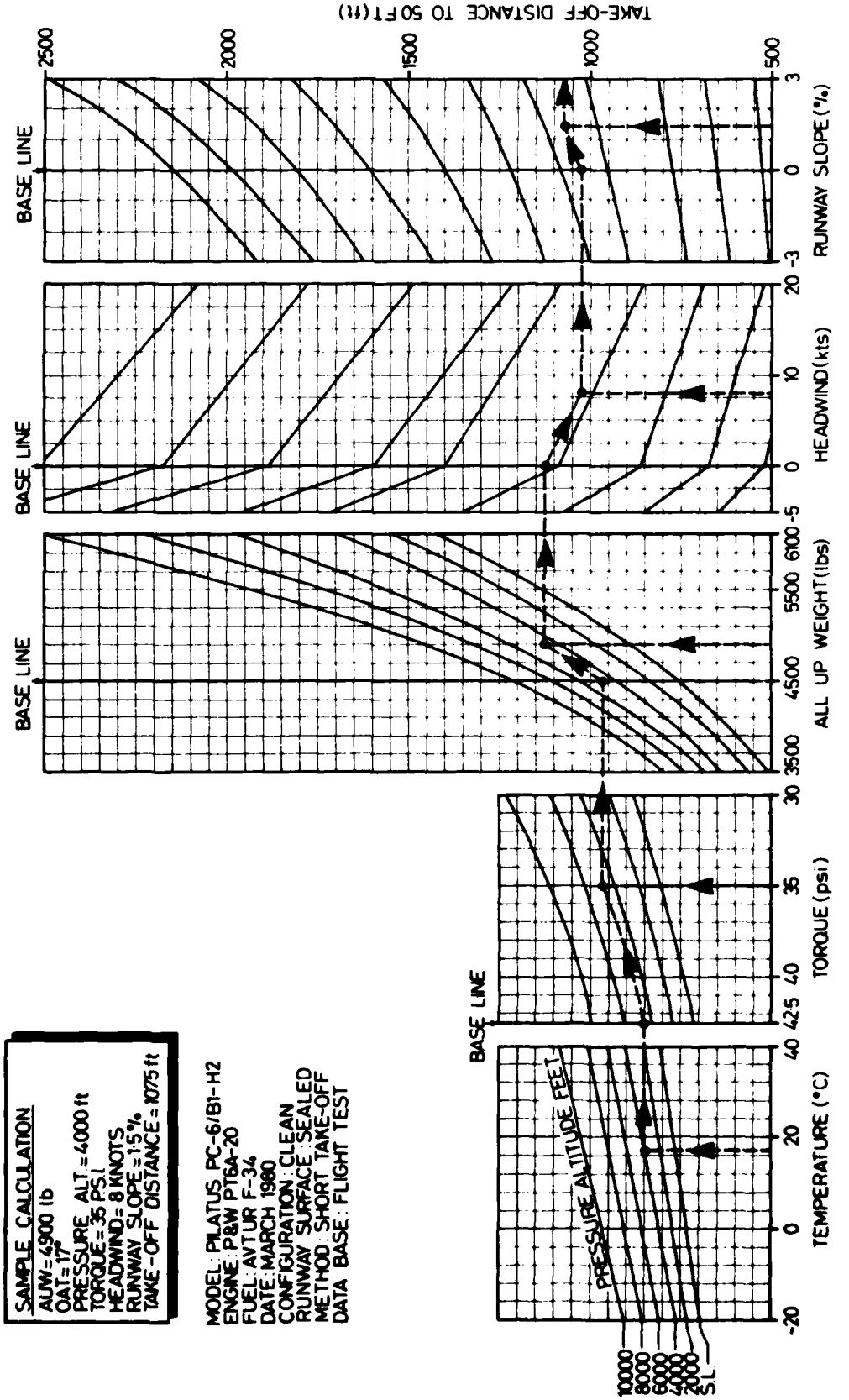
Project Pilots	:	SQNLDR P. SADLER BE, CAPT A. HASTIE
Project Engineer	:	FLTLT M.J. TOBIN ARMIT

ANNEX A TO
REPORT NO TI 698

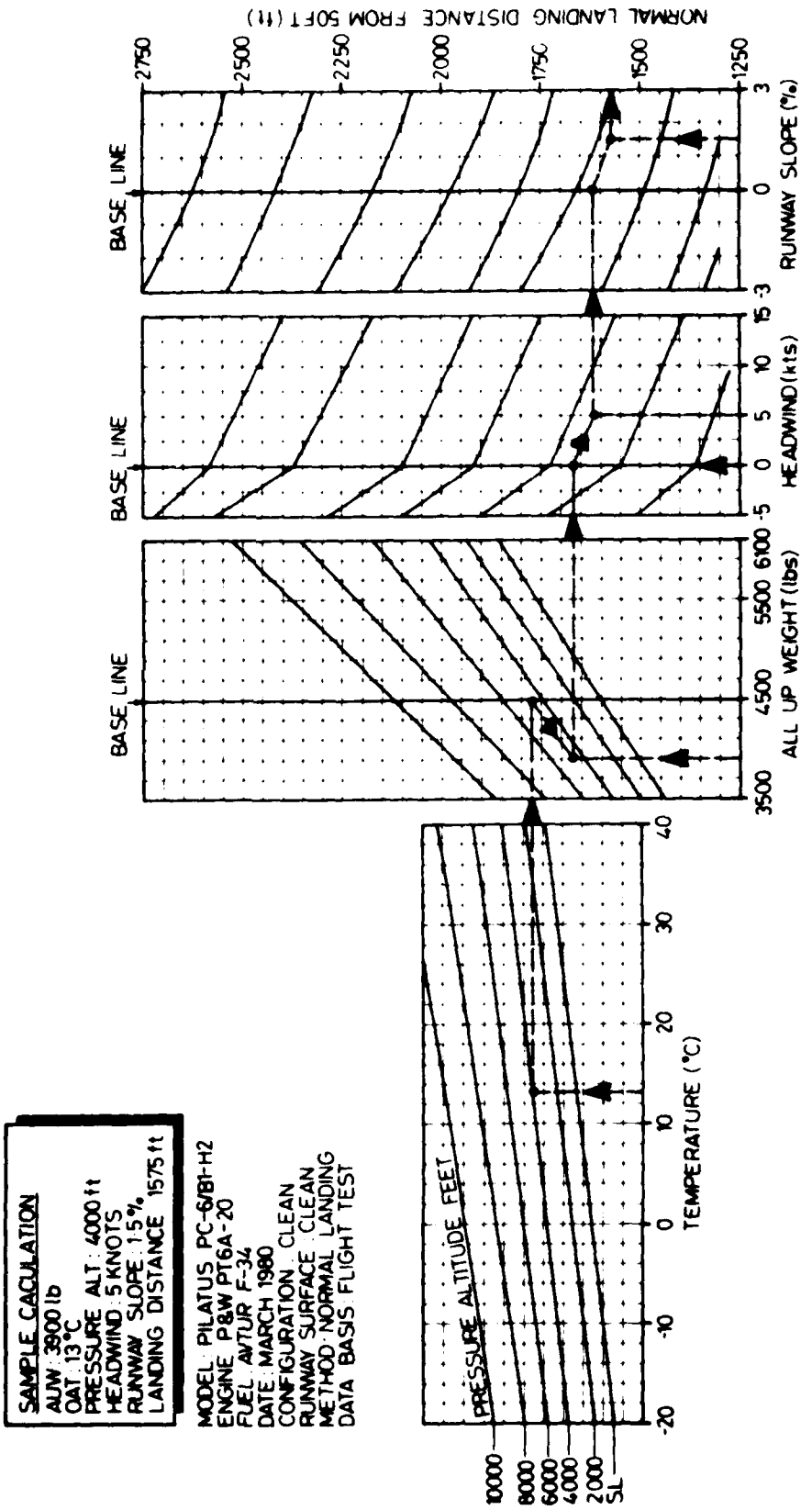
TAKE-OFF GROUND ROLL DISTANCE



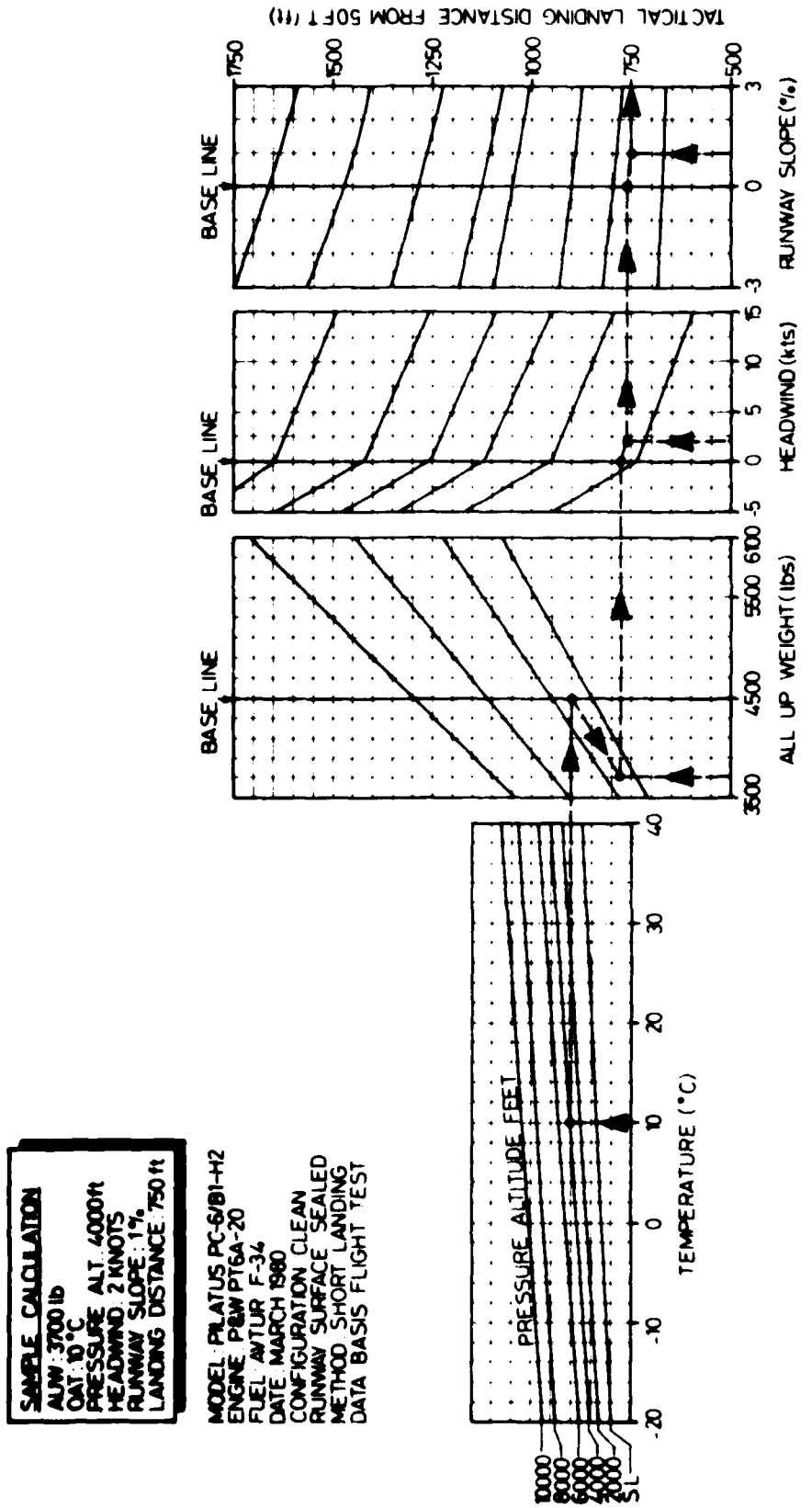
DISTANCE FOR TAKE-OFF AND CLIMB TO 50 FT



NORMAL LANDING DISTANCE FROM 50 FT



TACTICAL LANDING DISTANCE FROM 50 FT



AIRCRAFT RESEARCH AND DEVELOPMENT UNIT

TECHNICAL INVESTIGATION NO 698

PILATUS PORTER
PROVISION OF REVISED TAKE-OFF AND LANDING
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